

reflected from an interface or surface of the sample; and plotting the difference or function of the difference of the time of flight of the transmitted and reflected pulse relative to the time of flight of the reflected pulse.

(New) 46. The method of claim 44, wherein step (c) further comprises the steps of extracting the parts of the transmitted pulse which are due to an even number of reflections within the sample, and determining the position of an interface using the signal caused by said even number of reflections.

(New) 47. The method of claim 44, further comprising the step of detecting a reference signal obtained from an object having a known separation from either the emitter of irradiating beam or the sample to be imaged.

(New) 48. The method of claim 47, wherein the reference signal is obtained from a reflection off a component of the emitter.

(New) 49. The method of claim 44, wherein the irradiating beam has a beam diameter smaller than that of the smallest radiation wavelength of the beam.

(New) 50. The method of claim 44, wherein the irradiating beam is emitted by an emitter, the emitter being irradiated with at least one input beam of radiation with frequencies in the visible or near infra red frequency range, the emitter being a material with non-linear optical properties

(New) 51. The method of claim 47, wherein the input beam has a beam diameter which is smaller than the smallest wavelength of the beam of pulsed radiation of step (a).

(New) 52. The method of claim 50, wherein the emitter is a semiconductor.

(New) 53. The method of claim 50, wherein the material with non-linear optical properties is chosen from the group of LiIO₃, NH₄H₂PO₄, ADP, KH₂PO₄, KH₂ASO₄, Quartz, AlPO₄, ZnO,

CdS, GaP, GaAs, BaTiO₃, LiTaO₃, LiNbO₃, Te, Se, ZnTe, ZnSe, Ba₂NaNb₅O₁₅, AgAsS₃, proustite, CdSe, CdGeAs₂, AgGaSe₂, AgSbS₃, ZnS, DAST (4-N-methylstilbazolium) or Si.

(New) 54. The method of claim 50, where the sample is mounted such that there are no active optical components between the sample and the emitter.

(New) 55. The method of claim 50, wherein the emitter is configured to hold the sample.

(New) 56. The method of claim 50, wherein the sample is positioned with a separation from 10 mm to 500 mm from the emitter.

(New) 57. The method of claim 50, wherein the emitter is of a size such that radiation reflected from the sample can pass back through the emitter.

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(New) 58. The method of claim 50, wherein the emitter is substantially transparent to the irradiating beam.

(New) 59. A method according to claim 44, wherein a CCD camera is used to detect the radiation reflected from and transmitted through the sample.

(New) 60. The method of claim 44, wherein a three dimensional image is generated in step (c).

(New) 61. The method of claim 44, wherein a compositional image is generated in step (c).

(New) 62. An apparatus for imaging a sample, the apparatus comprising:-

a) means for irradiating a sample to be imaged with an irradiating beam of pulsed electromagnetic radiation with a plurality of frequencies in the range from 25GHz to 100THz;

b) means for detecting radiation which is both transmitted through and reflected from the sample; and

- c) means for generating an image of the sample from radiation detected in step (b).

(New) 63. The apparatus of claim 62, wherein the means for generating an image comprise means for calculating the time of flight of a pulse of radiation transmitted through the sample, means for calculating the time of flight of a pulse of radiation reflected from an interface or surface of the sample; and means for plotting the difference or a function of the difference in the time of flight of the transmitted and reflected pulse relative to the time of flight of the reflected pulse.

(New) 64. The apparatus of claim 62, wherein the means for generating an image of the sample comprise means for extracting the parts of the transmitted pulse which are due to an even number of reflections within the sample, and determining the position of an interface using the signal caused by said even number of reflections.

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(New) 65. The apparatus of claim 62, further comprising means for generating a reference signal.

(New) 66. The apparatus of claim 65, wherein the means for generating a reference signal comprise means for measuring a signal reflected from a component of the means for irradiating the sample.

(New) 67. The apparatus of claim 62, wherein the means for irradiating a sample, comprises an emitter for emitting the irradiating beam, the emitter having optical non-linear properties, such that when the emitter is irradiated with an input beam with a frequency in the visible or near infra-red frequency ranges, a beam is emitted with frequencies in the range from 25GHz to 100THz.

(New) 68. An apparatus according to claim 66, wherein the input beam of pulsed radiation has a diameter which is smaller than that of the smallest wavelength of the irradiating beam.

(New) 69. The apparatus of claim 62, wherein the means for detecting the radiation comprises a CCD camera for detecting the reflected radiation.

(New) 70. The apparatus of claim 62, wherein the means for generating an image of the sample comprises means for generating a three dimensional image of the sample.

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(New) 71. The apparatus of claim 62, wherein the means for generating an image of the sample comprising means for generating a compositional image of the sample.
